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RESEARCH ARTICLE

Prevalence and Risk Factors for Human Immunodeficiency Virus (HIV) and Syphilis Infections Among Military Personnel in Sierra Leone

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Abstract: ***Context*:** HIV and syphilis infections are common in military personnel in sub-Saharan Africa, which impact combat preparedness and increase demands on the military health care system. The prevalence of HIV is estimated at 1.5% among the general population (15-49 years of age) of Sierra Leone, and the estimated syphilis prevalence ranged from 1.5% to 5.2% based on regional studies. We examined the prevalence and risk factors for these two common sexually transmitted infections in the Sierra Leone military personnel.

***Methods*:** This cross-sectional study examined 1157 randomly selected soldiers from the Republic of Sierra Leone Armed Forces in 2013 using computer-assisted personal interviews and rapid testing algorithms. Descriptive statistics and logistic regression models were implemented to identify risk factors for HIV and syphilis separately.

***Results*:** The mean age of participants was 38 years, 11.1% were female, and 86.5% were married. The seroprevalence of HIV and syphilis were 3.3% (95% confidence interval [CI]: 2.3%-4.3%) and 7.3% (95% CI: 5.9%-8.8%), respectively. Lower educational attainment in women, multiple sexual partners, unintended sex after alcohol use and use of condoms were independently associated with HIV status ($p<0.05$). After adjustment, HIV infection was associated with female gender, unintended sex after alcohol use, condom use at last sex, having multiple sexual partnerships in the same week and HIV testing outside of military facilities ($p<0.05$). Increasing age, positive HIV status and rural regions of residence were associated with syphilis seropositivity.

***Conclusion*:** The prevalence of sexually transmitted infections among military personnel was higher than the general population of Sierra Leone. Several high-risk sexual behaviors that expose soldiers to HIV and syphilis could be addressed through prevention interventions.

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1. INTRODUCTION

Sexually transmitted infections (STIs), such as human immunodeficiency virus (HIV) and syphilis, potentially impact the Republic of Sierra Leone Armed Forces (RSLAF) by reducing their effectiveness and increasing the need for medical care. The RSLAF, which unites Army, Air Force and Navy, was established in 2002 after more than a decade of national civil war. It is tasked with protecting borders and national security. After a peak of around 13000 troops in 2007, the strength of the force was reduced to approximately 8500 members in 2010, by disbanding specific battalions and uniting others.

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In 2012, the national adult prevalence of HIV among those 15-49 years of age in Sierra Leone was estimated at 1.5% (95% confidence interval [CI]: 1.0%-2.1%), with an incidence of approximately 1.2 new infections per 1000 persons [1]. Mostly transmitted through heterosexual contact, principal risk factors for HIV transmission have been identified as having sex with a commercial sex worker and multiple sexual partnerships [2, 3]. Only 2% of new infections are believed to be attributed to male-to-male sexual contact, and 1% to injection drug use [2]. The prevalence of HIV varies regionally within Sierra Leone. The most populated region (Western) had an estimated general population prevalence of 2.9% in 2008, followed by the Eastern and Southern regions at 1.4% and 0.8%, respectively [4]. In 2012, studies of specific sub-populations, such as commercial sex workers (8.5%) and fishermen (3.8%), were estimated to have a higher HIV prevalence than the general population [5].

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Specific behaviors and factors increase the risk of sexually transmitted infections in African military personnel. The RSLAF have been documented to be at increased risk for acquiring HIV compared with the general population. Specifically, HIV prevalence in members of police forces (5.8%) and military (3.3%) are two to four times higher than that in the general population [6, 7]. Several observational studies performed in sub-Saharan African military settings have found that officers have more sexual partners than privates, probably because of increased financial resources. These studies also found less education and knowledge of harm-reducing sexual practices among the enlisted ranks [8, 9]. Moreover, soldiers often use the services of commercial sex workers who, in turn, report inconsistent condom use with clients [10, 11].

As expected from their shared mode of transmission, syphilis infections are more prevalent among patients with other STIs [12, 13]. Genital ulcers caused by primary syphilis promote the transmission of HIV [14, 15]. While there are no specific syphilis estimates available for Sierra Leone, the general population prevalence of syphilis is estimated to range from 1.5% to 5.2% in the Western region of Sub-Saharan Africa [16]. In 2007, a prevalence of 1.9% was reported among Sierra Leone military members [7]. Very few sub-Saharan countries have national estimates of both HIV and syphilis, but in Zambia, the national HIV prevalence is estimated at 17%, and the prevalence of syphilis is estimated 4.2% [17, 18]. HIV and syphilis co-infections can reveal a persistent pattern of risky sexual behaviors, most notably the inconsistent use of condoms and a high number of sexual partners [12].

The lack of detailed epidemiological evidence on sexual risk behaviors in the military population of Sierra Leone has hampered opportunities for prevention programs. This study describes the prevalence of HIV and syphilis in a stratified random sample of the 8500 members of the RSLAF and identifies behavioral risk factors for these STIs.

2. MATERIALS AND METHODS

2.1. Study Description

Following approval from the military and all ethics committees, data were collected from April to May 2013 from 14 military sites across Sierra Leone for this cross-sectional, bio-behavioral study. In order to obtain a representative sample of the armed forces, study sites were randomly selected from a list to represent the diversity of military brigades and battalions. Consenting participants responded to a structured, computerized personal interview performed by a trained study interviewer and were then tested for HIV and syphilis.

2.2. Geography of Study Sites

Study sites were categorized into the geographical regions of Sierra Leone. The Western region included the Western Area Rural and Western Area Urban districts; the Eastern region included the districts of Kono, Kenema and Kailahun; the Northern region included the districts of Port Loko, Tonkolili, Koinadugu, Bombali and Kambia; and the Southern region included the districts of Moyamba, Bo, Bonthe and Pujehun. Four sites were selected from the Western Area district, while two were selected from the Western Area Rural district. One military site was selected from each of the following districts: Kambia, Bombali, Koinadugu, Kono, Kailahun, Bo, Kenema and Pujehun.

2.3. Study Population

Male and female RSLAF members over the age of 18 at selected study sites were eligible to participate in the study. Individuals were selected based on a random stratified sampling scheme at each site. The stratification relied upon the military rank distributions (junior/senior officers, warrant officers/senior non-commissioned officers [NCOs], privates/junior NCOs) at each study site. All available females were invited to participate, and within each military rank strata, personnel were randomly selected to participate.

2.4. STI Testing

HIV testing was performed in series according to the national guidelines using Alere Determine HIV-1/2 (Alere Medical Co., Ltd., Tokyo, Japan) and Uni-Gold Recombigen HIV-1/2 (Trinity Biotech Plc, Bray, County Wicklow, Ireland). Syphilis status was assessed using DPP Screen & Confirm Assay (Chembio Diagnostic Systems Inc., Medford, NY, USA). HIV infection was diagnosed if both rapid tests performed in series were positive, and an HIV-negative status was determined if the first test of the algorithm was negative. A positive syphilis diagnosis required treponomal antibodies only regardless of reaginic antibody results and indicated either past or current syphilis infection.

2.5. Study Questionnaire

The questionnaire surveyed general demographics, such as age, birth district (categorized into regions), gender, marital status, military characteristics (in particular, military rank distributions as described earlier) and deployment history within the past 2 years. The second part of the questionnaire evaluated sexual behaviors, HIV testing history, utilization of testing services and alcohol use. Sexual intercourse was defined as vaginal and/or anal sex and did not include oral sex. Participants provided information on the number of sexual partners over their lifetime, history of multiple sexual partnerships within the same week, partner types in the past 12 months and transactional sex defined by trading goods or money in exchange for sex. Condom use at last sex (Yes/No) was combined for regular partners and casual partners, summarized into four categories: (1) “Yes” if a condom was used at last sex with any partner type; (2) “No” if no condom was used with any partner; and (3) “inconsistent condom use” if it was used with a regular partner only, or (4) with a casual partner only. Alcohol use was assessed with the Alcohol Use Disorders Identification Test (AUDIT) [19] and categorized as none (score of 0), low use (scores of 1-7) and harmful or hazardous use (scores $\geq$8).

2.6. Statistical Analysis

Frequencies for categorical variables and means/standard deviations for continuous variables were calculated for all participants and stratified by gender and HIV status. Chi-square or Fisher’s exact tests were used to compare categori-

cal variables, and one-way analysis of variance compared continuous variables by HIV status. P-values less than 0.05 were considered statistically significant. Logistic regression models were built separately to identify factors associated with positive HIV or syphilis serologies. Variables, which associated bivariately with HIV or syphilis seropositivity at $p \leq 0.2$, were included in the separate multivariable logistic regression models. No variables were included in the multivariable models based on *a priori* knowledge. No adjustments were made for multiple testing. All analyses were performed in SAS Version 9.3 (SAS Institute Inc., Cary, NC, USA), and all statistical tests were two-tailed.

2.7. Ethical Considerations

All participants enrolled in the study provided informed consent. In order to ensure complete comprehension of the study purpose and procedures, the consent form was read to the group in English and Krio (the local dialect understood by all) prior to the individual meeting with an interviewer to accept or decline participation. All participants who tested positive for HIV or syphilis were immediately referred to the medical unit for further clinical assessment and case management. This research was conducted in compliance with all applicable federal and local regulations governing the protection of human subjects in research and was approved by the appropriate institutional ethics review boards (Naval Health Research Center, Sierra Leone Ethics and Scientific Review Committee, San Diego State University Human Research Protection Program).

3. RESULTS

3.1. Prevalence and Regional Distributions of HIV and Syphilis

Of the 1193 consenting participants, the analysis was restricted to those with both syphilis and HIV test results and a completed questionnaire (n=1157; 97.0% of original sample). The overall HIV prevalence was 3.3% (95% CI: 2.3%-4.3%) among study participants, and the syphilis prevalence was 7.3% (95% CI: 5.9%-8.8%). The highest HIV prevalence was recorded in the Kailahun district (6.8%; 95% CI: 1.4%-12.2%) in the Eastern region, while the highest syphilis prevalence was in the Koinadugu district (18.4%; 95% CI: 10.1%-26.7%) in the Northern region (Table **1**). The HIV prevalence in the urban area of the Western region (3.2%; 95% CI: 1.5%-4.9%) was similar to the overall HIV prevalence of the study population.

3.2. Demographics of the Study Population

The mean age of participants was 38.5 years (95% CI: 38.0-38.9), and 43.3% were born in districts of the Northern region of Sierra Leone (Table **2**). Most participants were from study sites in the Western region (43.5); 25.4% were from the Northern region; 20.7% were from the Eastern region; and 10.4% were from the Southern region. A third of participants had no formal schooling or only reached a primary school level. Most participants (86.5%) were currently married or living with a partner, and 56.7% reported being Muslim. Privates, junior officers/NCOs and higher-ranking officers represented 41.1%, 40.1% and 18.8%, respectively, of the sample. HIV prevalence was observed to be higher among women (5.4%) than men (3.0%).

Table 1. Prevalence of HIV and syphilis among study participants by district of residence, Sierra Leone, 2013.

		HIV +		Syphilis +	
Site district	**Total**	**n**	**(%)**	**n**	**(%)**
Eastern region					
Kailahun	88	6	(6.8)	11	(12.5)
Kenema	73	3	(4.1)	11	(15.1)
Kono	79	2	(2.5)	6	(7.6)
Northern region					
Bombali	110	0	(0.0)	13	(11.8)
Kambia	97	3	(3.1)	4	(4.1)
Koinadugu	87	2	(2.3)	16	(18.4)
Southern region					
Bo	34	1	(2.9)	5	(14.7)
Pujehun	86	2	(2.3)	8	(9.3)
Western region					
Western Area Rural	96	6	(6.3)	0	(0.0)
Western Area Urban	407	13	(3.2)	11	(2.7)
Total	1157	38	(3.3)	85	(7.3)

3.3. Demographics of HIV-Infected Persons

A few demographic characteristics of HIV-infected persons varied by sex (Table **2**). The power to detect differences in women was limited by the small number of HIV-infected women in our study (7/129 = 5.4%). Age, study site and religion were not associated with HIV infection in either men or women. Education strongly correlated with HIV seropositivity in women, as those with only primary school educations were more likely to be positive than those with higher education levels (14.8% *versus* 2.9%, p=0.03). Men born in the Western and Southern regions were more likely to be HIV-positive, while no women born in the same regions screened positive. Men in the higher ranks (senior NCOs and officers) were more likely to be HIV-positive (5.1%) compared with men designated as privates (3.1%, p=0.08). In contrast, no women of higher military ranks were HIV-positive, while 4.9% of female privates were infected.

3.4. Risk Behaviors Influencing HIV Infection

Subjects who ever had multiple sexual partnerships in the same week were 2.3 times more likely to be HIV-positive (95% CI: 1.1-4.7; Table **3**). Military deployment, as defined by assignment away from their home base for at least six months, was not associated with HIV status. Among those who never had been tested for HIV (n=236), 3.4% screened HIV-positive during the study. Participants who had previously been tested for HIV only at civilian facilities were 3.1 times more likely to be HIV-positive compared with those

Table 2. Demographic characteristics by HIV status among participants, Sierra Leone, 2013.

	Total		Men (n=1028)					Women (n=129)				
			HIV -		HIV +		p-value	HIV -		HIV +		p-value
	N	(%)	n	(%)	n	(%)		n	(%)	n	(%)	
Age (years)[a]							0.29					0.83
Mean (SD)	38.5 (7.9)		39.1 (7.7)		40.6 (6.5)			33.2 (7.8)		33.9 (4.1)		
Birth region[a]							0.99					0.11
Western	161	(13.9)	115	(11.5)	4	(12.9)		41	(33.6)	0	(0.0)	
Southern	198	(17.1)	178	(17.9)	14	(45.2)		15	(12.3)	0	(0.0)	
Eastern	296	(25.6)	262	(26.3)	5	(16.1)		24	(19.7)	2	(28.6)	
Northern	501	(43.3)	440	(44.2)	8	(25.8)		42	(34.4)	5	(71.4)	
Education							0.65					0.03
None/Primary school	386	(33.4)	347	(34.8)	12	(38.7)		23	(18.9)	4	(57.1)	
JSS and beyond	771	(66.6)	650	(65.2)	19	(61.3)		99	(81.1)	3	(42.9)	
Religion							0.89					0.70
Muslim	656	(56.7)	591	(59.3)	18	(58.1)		44	(36.1)	3	(42.9)	
Christian	501	(43.3)	406	(40.7)	13	(41.9)		78	(63.9)	4	(57.1)	
Current relationship status							0.08					0.63
Single	103	(8.9)	64	(6.4)	0	(0.0)		38	(31.1)	1	(14.3)	
Married or living with a partner	1001	(86.5)	898	(90.1)	28	(90.3)		70	(57.4)	5	(71.4)	
Widowed/divorced/separated	53	(4.6)	35	(3.5)	3	(9.7)		14	(11.5)	1	(14.3)	
Military rank							0.08					0.22
Private	475	(41.1)	381	(38.2)	13	(41.9)		77	(63.1)	4	(57.1)	
Junior NCO	464	(40.1)	430	(43.1)	8	(25.8)		23	(18.9)	3	(42.9)	
Senior NCO/WO/Junior Officer/Senior Officer	218	(18.8)	186	(18.7)	10	(32.3)		22	(18.0)	0	(0.0)	
Site location							0.25					0.57
Eastern	240	(20.7)	220	(22.1)	11	(35.5)		9	(7.4)	0	(0.0)	
Western	503	(43.5)	407	(40.8)	13	(41.9)		77	(63.1)	6	(85.7)	
Southern	120	(10.4)	104	(10.4)	2	(6.5)		13	(10.7)	1	(14.3)	
Northern	294	(25.4)	266	(26.7)	5	(16.1)		23	(18.9)	0	(0.0)	
Total	1157		997	(97.0)	31	(3.0)		122	(94.6)	7	(5.4)	

JSS, junior secondary school; NCO, non-commissioned officer; WO, warrant officer.[a] n=1156; p-value from chi-square or Fisher's exact test.

who had never been tested prior to the study (95% CI: 1.1-8.9). However, the number of times participants were screened for HIV since joining the military was not associated with their HIV status. Among those with low levels of alcohol use (n=317), 4.7% were HIV-positive compared to 3.4% among heavier users. The lifetime number of sexual partners was not associated with HIV infection in this population. Having both regular and casual sex partners in the past year was associated with HIV status compared with those having no sex partners. Only a small fraction (9.5%) had ever traded goods or money in exchange for sex, but this was not associated with HIV status (p=0.44). Having unintended sex resulting from alcohol drinking increased the likelihood of a positive HIV status by 3.9 times (95% CI:

Table 3. Odds of having a seropositive status by risky behaviors among study participants, Sierra Leone, 2013.

	Total		HIV +			
	N	(%)	n	(%)	OR (95% CI)	p-value
Multiple sex partners in the same week						
Yes	205	(17.7)	12	(5.9)	2.30 (1.14-4.66)	
No	950	(82.3)	25	(2.6)	1 [Reference]	
Have been deployed locally for six months or more in the past 2 years						
Yes	511	(44.2)	15	(2.9)	0.82 (0.42-1.59)	
No	646	(55.8)	23	(3.6)	1 [Reference]	
Ever taken an HIV test						0.02
Yes at a military facility only	709	(61.3)	20	(2.8)	0.82 (0.36- 1.90)	
Yes at an outside facility	71	(6.1)	7	(9.9)	3.12 (1.09-8.92)	
Yes at both military and outside facilities	141	(12.2)	3	(2.1)	0.62 (0.16-2.38)	
No	236	(20.4)	8	(3.4)	1 [Reference]	
Number of times tested for HIV since joining the military						
0-1	408	(35.3)	15	(3.7)	1.75 (0.67-4.57)	
2-3	428	(37.0)	16	(3.7)	1.78 (0.69-4.61)	
4+	281	(24.3)	6	(2.1)	1 [Reference]	
Unknown	40	(3.5)	1	(2.5)	1.18 (0.14-10.02)	
Alcohol use						0.21
None	663	(57.3)	17	(2.6)	1 [Reference]	
Low use	317	(27.4)	15	(4.7)	1.89 (0.93-3.83)	
Harmful or hazardous use	177	(15.3)	6	(3.4)	1.33 (0.52-3.43)	
Number of sexual partners over lifetime						
1	190	(16.4)	6	(3.2)	1 [Reference]	
2	158	(13.7)	4	(2.5)	0.80 (0.22-2.87)	
3+	320	(27.7)	8	(2.5)	0.79 (0.27-2.30)	
Unknown	489	(42.3)	20	(4.1)	1.31 (0.52-3.31)	
Partner types in the past year						0.74
Regular or casual only	799	(69.1)	24	(3.0)	0.59 (0.13-2.58)	
Regular and casual	317	(27.4)	11	(3.5)	0.68 (0.15-3.20)	
None	40	(3.5)	2	(5.0)	1 [Reference]	
Ever traded sex for goods or money						0.44
Yes	110	(9.5)	4	(3.6)	1.46 (0.56-3.83)	
No	1047	(90.5)	33	(3.2)	1 [Reference]	
Unintended sex as result of alcohol drinking						
Yes	58	(5.0)	6	(10.3)	3.85 (1.54-9.61)	
No	1099	(95.0)	32	(2.9)	1 [Reference]	
Condom use at last sex[a]						0.04
CU with any partners	268	(23.6)	16	(6.0)	2.47 (1.24-4.92)	
CU only with regular partner	43	(3.8)	2	(4.7)	1.90 (0.43-8.46)	
CU only with casual partner	94	(8.3)	1	(1.1)	0.42 (0.06-3.17)	
No CU with any partners	719	(63.4)	18	(2.5)	1 [Reference]	

CI, confidence interval; CU, condom use; OR, odds ratio. [a] Excluding those who did not have sex in the past six months (n=23) or missing responses (n=10).

1.5-9.6). Condom use at last sex with regular or casual partners was significantly associated with HIV status; those who used a condom at last sex were 2.5 times more likely to have HIV compared with those who did not use a condom (95% CI: 1.2-4.9).

The final logistic regression model found five primary factors associated with the odds of HIV seropositivity: female gender, HIV testing history outside the military, condom use with any partners, multiple sexual partnerships in the same week and unplanned sexual encounters after a drinking session (Table **4**). Marital status did not significantly affect HIV status after considering the factors mentioned above.

Table 4. Adjusted odds of being HIV positive among study participants, Sierra Leone, 2013.

	AOR (95% CI)	p-value
Gender		0.04
Female	2.72 (1.07-6.90)	
Male	1 [Reference]	
Marital status		0.08
Married or living with a partner	1 [Reference]	
Single	0.16 (0.02-1.27)	
Widowed/divorced/separated	2.18 (0.68-7.04)	
Ever been tested for HIV		0.03
No	1.27 (0.51-3.16)	
Yes, at an outside facility	3.91 (1.50-10.18)	
Yes, at both types of facilities	0.71 (0.20-2.46)	
Yes, at a military facility only	1 [Reference]	
Multiple sex partners in the same week		0.03
Yes	2.37 (1.11-5.06)	
No	1 [Reference]	
Unintended sex as result of alcohol drinking		0.03
Yes	3.03 (1.13-8.15)	
No	1 [Reference]	
Condom use[a]		0.02
CU with any partners	2.82 (1.38-5.76)	
CU only with regular partner	1.80 (0.39-8.31)	
CU only with casual partner	0.46 (0.06-3.50)	
No CU with any partners	1 [Reference]	

AOR, adjusted odds ratio (adjusted for all variables in the model); CI, confidence interval; CU, condom use.
[a] Excluding those who did not have sex in the past six months (n=23) or missing responses (n=10).

3.5. Factors Associated with Syphilis Status

Syphilis seropositivity was increased by older age, HIV infection and the geographical location where the participant was posted (Table **5**). In the multivariate model, a 1-year age increment increased the likelihood of being syphilis-positive by 4% (95% CI: 1%-7%). After adjusting for age and location, HIV-positive participants were 3.4 times more likely to be syphilis-positive in contrast to HIV-negative participants (95% CI: 1.4-8.3). Compared with military members posted in the Western region, those posted at rural sites in the Northern, Eastern and Southern regions combined were 6.1 times more likely to test positive for syphilis (95% CI: 3.2-11.8).

Table 5. Adjusted odds of being positive for syphilis among study participants, Sierra Leone, 2013

	AOR (95% CI)
Age (years)[a]	1.04 (1.01-1.07)
HIV status[a]	
Positive	3.35 (1.36-8.28)
Negative	1 [Reference]
Site region[a]	
Rural regions	6.14 (3.20-11.77)
Western Region	1 [Reference]

AOR, adjusted odds ratio (adjusted for all variables in the model); CI, confidence interval.
[a] p-value <0.001.

4. DISCUSSION

The overall prevalence of HIV in RSLAF study participants is more than twice that of the general population (3.3% *versus* 1.5%). The HIV prevalence identified in this study is similar to the results from a study performed among the RSLAF in 2007 [7]. The 2007 study, as well as the present study (2013), only had five sites in common. These sites were located in the districts of Bo, Bombali, Kambia, Pujehun and Western Area Urban. HIV prevalence decreased at all of these repeat sites in the 5-year interval between the earlier 2007 study and our study. Nonetheless, this decline in prevalence did not change the overall HIV prevalence, possibly due to the increased coverage achieved in the current study. Interestingly, the age-specific HIV prevalence differed between the two studies (2007 *versus* 2013). For example, we observed the highest HIV prevalence among those who were 20-39 years of age, whereas those 40-59 years of age had the highest HIV prevalence among those surveyed in 2007. There are a number of possible explanations for this difference including different sampling methodologies. Primarily, only 700 soldiers were sampled at a limited number of sites in 2007. Secondly, 45% of the participants studied here were 40-59 years of age (n=423), but the same age group only represented 23% of the sample in 2007 (n=163).

Compared with regional differences in the 2012 national HIV prevalence described earlier, the highest HIV prevalence among soldiers in this study was observed in the rural Eastern region but not in the Western region. Unstudied factors favoring sexual transmission of HIV specific to these localities may account for this difference. While not studied in our survey, rural regions have fewer jobs, making soldiers with steady incomes attractive for sexual partnerships. Furthermore, the Eastern region of the country has a common border with Northern Liberia and Southeastern Guinea where regional HIV prevalence is higher, especially among adult women [20, 21].

Risk factors for HIV infection included having multiple partnerships in the same week, being female, having HIV tests outside of military health facilities, unplanned sex after a drinking session and using condoms with all partners. Properties intrinsic to the military environment, such as deployment within the national territory and cohort effects (e.g., rank), did not appear to affect HIV status. The military of Sierra Leone has only been in its present organization since 2010, and the combination of restructuring and reshuffling caused by the civil war may have diluted the cohort effects typically seen in other military environments [22]. Only a few higher-ranking officers had been on an international deployment in the past 2 years, to destinations with lower HIV prevalence than Sierra Leone, such as East Timor, Sudan and Lebanon. A larger proportion of older male, higher-ranking officers was HIV-positive compared with younger privates and junior NCOs (5.1%, 3.3% and 1.8%, respectively), a finding previously reported in similar contexts [23, 24]. Similar to the United States, the RSLAF has been testing new recruits for HIV before entry since 2004, does not discharge HIV-positive soldiers and provides continued care [25]. However, routine force-wide testing is not feasible for current military personnel in this limited resource setting. The majority of testing is done passively through contact with health care providers or over the course of HIV-testing campaigns.

In our study, the association of HIV status and condom use at last sexual intercourse was found to be opposite to the established pattern in the literature. Barrier prevention has been found to consistently reduce transmission of HIV and other STIs [26, 27]. Potential confounders, such as marital status, age and partner types that have been shown to influence condom use behavior elsewhere, did not change the magnitude nor the direction of the association with HIV status in this study [8, 28, 29]. However, non-consistent condom use observed in the current study has been reported in a similar military context [30]. In a survey of Nigerian soldiers, consistent condom use, regardless of partner type, was reported among less than 20% of participants [30]. One explanation for our findings is that HIV-positive soldiers may have increased condom use after realizing their increased risk. Moreover, we did not find increased high-risk behavior, such as higher number of sexual partners, among HIV-positive condom users. While only 7 participants reported knowing that they were HIV-positive (data not shown), the data collection by personal interview could increase reluctance to disclose one's HIV status. Moreover, the HIV prevention messaging and campaign spread among the troops may have had an impact. The military should continue to emphasize consistent condom use, especially when multiple concurrent partnerships are involved with possibly steady or casual partners.

Our study results suggest that those who obtained HIV testing previously at civilian clinics only were more likely to be HIV-positive than those who had been tested at military facilities. Issues with available military HIV-testing structures could explain this observation. For instance, some participants cited the unavailability of test kits and mistrust of counselors as deterrents from using military HIV-testing services (data not shown). Other additional reasons not studied could lead to testing outside of the military environment. Furthermore, 1 in 5 study participants had not previously taken an HIV test; of these, about 3.4% were HIV-positive, revealing persisting barriers to HIV testing. The perceived lack of confidentiality and persistent stigmatization of HIV likely represent the primary barriers to testing among military members [31]. The reasons for these barriers to HIV testing warrant further research to facilitate testing and improve care.

Risk factors for syphilis included age, HIV status and geographic location. Our findings are consistent with previous studies describing increased risk of HIV transmission among patients with syphilis [32, 33]. To our knowledge, this study is the first detailed description of risk factors for syphilis in an adult population in Sierra Leone. The only previous study of syphilis seroprevalence in this population found a lower rate of 1.9% [7]. Moreover, past studies performed in other sub-Saharan African countries, have shown that syphilis was more prevalent in rural regions compared with urban environments, probably because of reduced access to health care and education [34].

4.1. Strengths and Limitations

This study had several strengths. Random multi-level sampling of military personnel throughout the country seems to have resulted in a representative sample and increased its applicability to the entire military population of Sierra Leone. The use of computer-assisted personal interviews may have helped to reduce bias in recalling private sexual behaviors and increase data quality using automated audits for inconsistent responses [35, 36]. Study limitations were related to the cross-sectional research design and relatively low prevalence of the two infections of interest. We relied on self-reported sexual behaviors over either a 1-year or 2-year period (during military deployments). We were unable to determine the time of infection from serological data and thus do not know which sexual behavior was concurrent with the time of infection. The cross sectional design limited our ability to draw conclusions from past military deployments. Recall time frames were limited to the past 12 months; however, some participants may have changed their behavior if they acquired an STI more than a year ago. A low prevalence of HIV and syphilis limited the precision of our estimates and power to detect risk factors for these infections. Lastly, we did not address the issues of sexual coercion and rape that may have contributed to increased risk in lower-ranking military women.

CONCLUSION

In summary, HIV prevalence among members of the Sierra Leone military remains about twice that of the general population, and those with syphilis also have a high HIV prevalence. Outreach efforts should target the highest risk subsets of the population, such as low-ranking female soldiers and male officers. These efforts should encourage behavior changes aimed at reducing high-risk sexual behaviors, such as decreasing numbers of contemporaneous sexual partners and using alcohol in moderation.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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This work represents report 15-19, supported by the Department of Defense HIV/AIDS Prevention Program, under Work Unit No. 60546. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of the Army, Department of the Air Force, Department of Veterans Affairs, Department of Defense or the US Government. Approved for public release; distribution is unlimited. US Government Work (17 USC 105). Not copyrighted in the US. This research was conducted in compliance with all applicable federal regulations governing the protection of human subjects (Protocol NHRC.2013.0011).

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14. ABSTRACT

Abstract: Context: HIV and syphilis infections are common in military personnel in sub-Saharan Africa, which impact combat preparedness and increase demands on the military health care system. The prevalence of HIV is estimated at 1.5% among the general population (15-49 years of age) of Sierra Leone, and the estimated syphilis prevalence ranged from 1.5% to 5.2% based on regional studies. We examined the prevalence and risk factors for these two common sexually transmitted infections in the Sierra Leone military personnel.

Methods: This cross-sectional study examined 1157 randomly selected soldiers from the Republic of Sierra Leone Armed Forces in 2013 using computer-assisted personal interviews and rapid testing algorithms. Descriptive statistics and logistic regression models were implemented to identify risk factors for HIV and syphilis separately.

Results: The mean age of participants was 38 years, 11.1% were female, and 86.5% were married. The seroprevalence of HIV and syphilis were 3.3% (95% confidence interval [CI]: 2.3%-4.3%) and 7.3% (95% CI: 5.9%-8.8%), respectively. Lower educational attainment in women, multiple sexual partners, unintended sex after alcohol use and use of condoms were independently associated with HIV status ($p<0.05$). After adjustment, HIV infection was associated with female gender, unintended sex after alcohol use, condom use at last sex, having multiple sexual partnerships in the same week and HIV testing outside of military facilities ($p<0.05$). Increasing age, positive HIV status and rural regions of residence were associated with syphilis seropositivity.

Conclusion: The prevalence of sexually transmitted infections among military personnel was higher than the general population of Sierra Leone. Several high-risk sexual behaviors that expose soldiers to HIV and syphilis could be addressed through prevention interventions.

15. SUBJECT TERMS

Africa, HIV, military, sexual behaviors, Sierra Leone, syphilis

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